ELECTRICAL RESISTIVITY OF SILVER FOILS UNDER SHOCK-WAVE COMPRESSION

ABSTRACT

Resistance changes in silver foils were monitored during uniaxial shock compression. Foils of 15 to 25 micrometers thickness were subjected to pressures of 25 to 120 kilobars. Calculations based on the Debye model of a solid generate a reference curve of isothermal resistivity versus hydrostatic pressure which, when a single parameter is adjusted, agrees with the 0 to 30 kilobars Bridgman results. The shock isothermal resistivity is significantly higher than the hydrostatic value for the same pressure; deviation is attributed to resistivity of lattice imperfections generated by the plastic deformation associated with uniaxial shock compression. The amount of deviation of the resistivity depends on initial purity of the silver. The deviation may also have a slight dependence on state of anneal of the foil. Lattice defect concentrations deduced from the resistivity deviations increase as the three-halves power of strain. Using published values for resistivity per vacancy in silver, computed vacancy concentrations at 100 kilobars are about 10^{-3}. A dislocation model for defect production in shock deformation is reviewed. A particular model involving stress relaxation is introduced to explain the observed effect of specimen purity on shock-induced resistivity change.